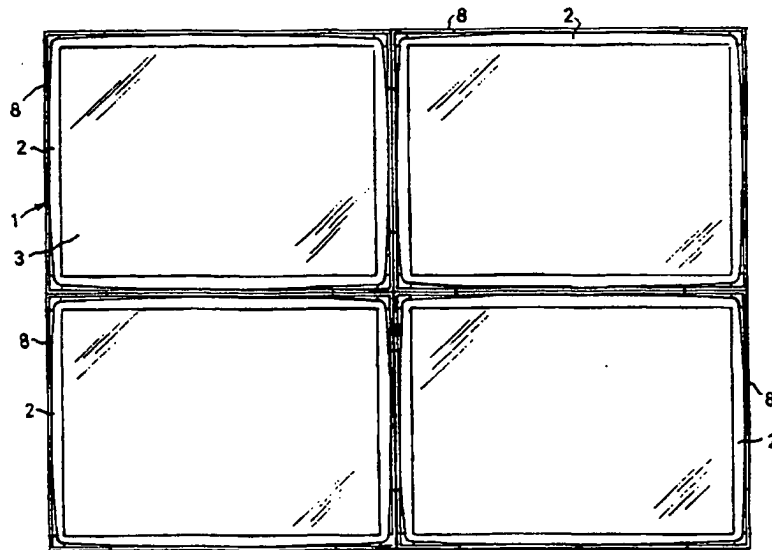


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## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<b>(21) International Application Number:</b> PCT/GB94/00125 <b>(22) International Filing Date:</b> 21 January 1994 (21.01.94) <b>(30) Priority Data:</b> 9301279.7 22 January 1993 (22.01.93) GB 9313421.1 29 June 1993 (29.06.93) GB <b>(71) Applicant (for all designated States except US):</b> C.D. INTERACTIVE LTD. [GB/GB]; 6 Odham Trading Estate, Watford, Hertfordshire WD2 5RE (GB). <b>(72) Inventor; and</b> <b>(75) Inventor/Applicant (for US only):</b> LEWIS, Marcus [GB/GB]; C.D. Interactive Limited, 6 Odham Trading Estate, Watford, Hertfordshire WD2 5RE (GB). <b>(74) Agent:</b> MAURY, Richard; Marks & Clerk, 57-60 Lincoln's Inn Fields, London WC2A 3LS (GB).		<b>(81) Designated States:</b> AT, AU, BB, BG, BR, BY, CA, CH, CN, CZ, DE, DK, ES, FI, GB, GE, HU, JP, KP, KR, KZ, LK, LU, LV, MG, MN, MW, NL, NO, NZ, PL, PT, RO, RU, SD, SE, SK, UA, US, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).  <b>Published</b> <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i>

**(54) Title:** VIDEO DISPLAY SYSTEM**(57) Abstract**

A video module for a video wall, comprising an assembly of multiple video display units whose front edges are abutting and are all in the same plane as a rectangular array, and a common box-shaped enclosure for the assembly. The image shown on the display units is switchable between modes, appearing as several identical images or else as just one, larger, image. A cathode ray tube is also disclosed with corner mounting lugs specially formed such that their edges do not project beyond the tangents from the major edges of the screen. A sleeve for a cathode ray tube is also disclosed, in the form of an open ended rigid box with formations on the inside of the corners for fixture to corner lugs of the cathode ray tube: the side walls of the box are partially broken away at the front edges to allow the edges of the cathode ray tubes supported therein to touch one another.

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Video Display System

This invention relates to video image processors and to video display systems, suitable for video walls. Video walls are banks of video display units arranged adjacent one another in the same plane, so as to cooperate in displaying images to a larger scale. Such video walls are to be installed in football stadia or department stores, for example.

The invention, in one aspect, provides a video display module for a video wall, comprising an assembly of video display units whose front edges are abutting and are all in the same plane in a rectangular array, and a common box-shaped enclosure for the assembly.

By providing mechanical support for the video display units at the front of the module, it is possible to provide spacing between the interior portions of the display units to allow mutual communication for the purposes of electronic control. In comparison with previous arrangements, where each video display unit retains its own housing, there is no need to break through the housings in order to achieve mutual communication. There is also sufficient space in the common enclosure in which to mount the common control circuitry which is also provided in accordance with the invention and is specified more particularly below.

Preferably, the assembly includes support means for attachment to corresponding support means on an adjacent such video display module whereby to join the modules face to face with all the front edges lying in the same plane.

Preferably, the support means includes a load-bearing frame which holds the front edges rigidly adjacent one another, against the bending moment of the weight of each video display unit, and also is capable of supporting the weight of at least one such module from above, under compressive loading, or at least one

such module suspended below, under tensile loading. Thus the modules are stackable, either resting on a support, or suspended, for example by hawsers, from a ceiling.

The support means may advantageously comprise bolts for releasably connecting the frames across an interface between two such modules, upon access from the interior of just one of the modules. The support means preferably comprises means for attaching hawsers for suspending the module.

The enclosure preferably comprises panels releasably attachable to the frame to form an exterior wall of the module or an exterior wall of two or more joined modules. The modular video wall system which would be assembled from such modules is readily reconfigurable, simply by removing or reattaching such panels, so that the panels form only the exterior surface and do not form part of the interior of the composite video wall structure.

With regard to the electronic control aspect, the invention also provides a video display system comprising a plurality of video display units arranged in a rectangular array, and an electronic control system arranged to receive one or more video input signal(s) and to display the signal(s), and switchable between modes either to make the image appear over two or more units with different parts shown on different units, or else to make the whole image appear on each of two or more units.

Preferably, the system comprises a programmable memory for a predetermined sequence of switching between the said modes and/or between different signal sources.

Preferably, the system includes a remote master control system which controls the operation of two or more of the said video display systems.

The system preferably includes means for mixing video inputs from different sources.

The invention also provides a video display module for a video wall comprising a plurality of video display units and a common housing, and a switched mode power supply connected to supply all the display units.

From another aspect, the invention provides a video display module for a video wall comprising a plurality of video display units and a common housing, and an electric lamp inside the housing for illuminating the interior for servicing and of sufficient power to provide anti-frost and anti-condensation protection for the interior when the module is used outdoors.

The invention also provides a video image processor for controlling a plurality of video display units in a video wall, comprising means for digitizing the input video signal and providing the digitized signal to each of the video display units, a system manager for providing matrix manager signals for controlling the distribution of the digitized signals to the different video display units, in accordance with the number and disposition of video display units in the video wall, and a clock generator for sequencing the supply of the digitized signals to the video display units with a frequency which depends on the number of video display units. In this way, the processor is of universal application irrespective of the number of video display units, or at least irrespective of the number of 2 x 2 modules being for example 1, 4, 16 or 64.

The invention also provides a cathode ray tube with corner mounting lugs specially formed such that their edges do not project beyond the tangents from the major edges of the screen, to allow four such tubes to be assembled in a 2 x 2 module with at least the middle portions of their adjacent edges contiguous. The lugs may include a recess on the diagonal line of the tube, for receiving a clamping bolt.

The invention also provides a sleeve for a cathode ray tube, in the form of an open-ended rigid box, a

front open end of the box comprising a rectangular-section frame supporting the screen of the cathode ray tube, with formations on the inside of the corners adapted for fixture to corner lugs of the cathode ray tube. The sleeve enables the module to be assembled by just one person, by adding one screen at a time to a suitable frame, the frame providing independent support for each of the sleeves.

The sleeve may also take the form of an open-ended rigid box, a front open end of the box comprising a rectangular-section frame for supporting the screen of the CRT, the frame having openings over the middle portions of its four front edges, intermediate its corners, to allow the edges of the screen to touch a corresponding edge of the screen supported in an identical sleeve with the screens co-planar.

The invention also provides a pre-assembly comprising a cathode ray tube held rigidly within a sleeve as defined above; and also provides a video display module comprising a frame adapted to receive serially, and to provide independent support for, a plurality of such pre-assemblies.

Embodiments of the invention will be described below by way of example only, with reference to the accompanying drawings, in which:

Fig. 1 is a front view of a 2 x 2 module,

Fig. 2 is a front view of the peripheral band of a conventional cathode ray tube screen, together with corner lugs,

Fig. 3 is a view corresponding to Figure 2 but of a cathode ray tube modified in accordance with the invention,

Fig. 4 is a front view, to a slightly reduced scale, of one of the four sleeves of the 2 x 2 module of Figure 1,

Fig. 5 is a left-hand side view of the sleeve of Figure 4,

Fig. 6 is a top plan view of the sleeve of Figures 4 and 5,

Fig. 7 is a greatly enlarged perspective view of the top left-hand corner, viewed from above and from the left, of the sleeve of Figures 4-6, including a corner-fixing bracket, and

Fig. 8 is a schematic block diagram of the electrical arrangement in the module.

The video wall module shown in Figure 1 consists of four cathode ray tubes 3 mounted independently in sleeves 8 which are themselves supported in a 2 x 2 array in a common frame. This frame also houses electronic control circuitry, described below with reference to Figure 8. This module 1 can be used as a self-contained unit on its own, or joined with other such modules to create a video wall of 2 x 2, 4 x 4, 8 x 8, 8 x 16, 16 x 16, or 16 x 32, cathode ray tubes, for example. It should however be understood that modules of other shapes, such as 1 x 3, are also feasible, and can create video walls of different array dimensions. The electronic control is designed to adapt to any required configuration, as will be described in greater detail below.

Each cathode ray tube screen or monitor 3 has a substantially rectangular screen area, of the flatter-squarer tube form (FST), which in this example is 21 inches (53 cm) across the diagonal, and is bounded by a rectangular margin 2 with a slightly curved periphery. The periphery of the screen is surrounded by a metal band 4, omitted in Figure 1 for the sake of clarity but shown in Figure 3. It is the outer dimensions of this band 4 which represent the maximum dimensions of the monitor 3, and define the limit on how close the picture areas can be on adjacent screens. With the benefit of the invention, the distance between the picture areas is the minimum: it is simply the sum of the widths of the margin 2 and the metal band 4,

multiplied by 2. The thickness of the sleeve 8 is the same as that of the metal band 4, so that the metal bands 4 of adjacent screens 3 are just touching.

Conventional cathode ray tubes or monitors have corner fixing lugs 5 as shown in Figure 2 which generally have portions projecting beyond the tangents 7 to the peripheries of the screen taken at the midpoints of the edges of the screen. These projecting portions would interfere with one another and would restrict the proximity achievable in the array of Figure 1. Accordingly, with the benefit of the present invention, these corner fixing lugs are adapted to the form shown in Figure 3. In Figure 3, each corner fixing lug 6 lies within the tangents 7, avoiding mutual interference. It is possible to adapt a conventional monitor to the form shown in Figure 3, simply by cropping the lugs with a suitable tool.

The module 1 is designed for assembly by just one person, if necessary. It is assumed that one person cannot easily carry more than one monitor at a time, so the module is designed for assembly by the successive addition of the monitors into a fixed frame. With the benefit of the invention, this is achieved by forming pre-assemblies consisting of the monitor 3 and a sleeve 8 as shown in Figures 4-6. Each pre-assembly can be handled independently, and can be slid into place in the stationary framework. The frame is not shown in the drawings, but is of conventional box shape, sufficient to accommodate the four pre-assemblies.

The front face of the frame consists of a rectangular structure whose outer edge coincides with that of the assembly of sleeves shown in Figure 1. This rectangular structure is braced by horizontal and vertical struts crossing at the centre of the rectangle, and corresponding in position to the interfaces between the sleeves 8 of Figure 1. The frame also has side pieces and a rear face, all of which provide additional



support for the sleeves 8. In particular, the sides, top and bottom of the box-shaped frame are preferably formed with rails for guiding and supporting the sleeves so that no sleeve relies on any other sleeve for support.

With reference to Figures 4-6, the sleeve 8 is an open-ended rectangular box, designed to house the monitor. The front portion 81 is a rectangular-section frame supporting the screen of the cathode ray tube, by means of corner plates 82, shown more clearly in Figure 7, to which corner lugs 6 of the monitor may be attached. This front frame 81 has openings 83, rectangular in shape, over the middle portions of its four front edges, intermediate its corners. These openings 83 allow the edges of the screens, i.e. the metal bands 4, to touch one another, when two pre-assemblies are placed adjacent one another.

As shown more clearly in Figure 7, a corner-fixing bracket 9, with a pair of holes 91, is provided for gripping the corner-fixing lug 6 between the plate 82 and the bracket 9. A pair of bolts 93 extending through holes 92 in the sleeve 8 are screwed into the internally-threaded holes 91 of the bracket 9 to secure it in the corner of the sleeve.

The sleeve 8 further comprises full-length rectangular wall panels 86R and 86B on the right-hand side and at the base, respectively; and approximately half-size wall panels 86L and 86T at the left-hand side and at the top, respectively. The front edges of these wall panels depend from flanges 85 of shoulders 84 at the rear of the front rectangular-section frame 81. Each wall panel is formed with ventilation grilles 87. The walls define a rear section of the sleeve 8, protecting the cathode ray tube behind the screen. The dimensions of the rear portion of the sleeve 8 are slightly smaller, by virtue of the shoulder 84, so that they can slot into the support frame (not shown) of the

module 1. Thus the external faces of the support frame, or of closure panels mounted over the support frame, can then be flush with the outer faces of the front rectangular-section frame 81 of the sleeve.

Thus the weight of the sub-assembly is borne by the support frame of the module primarily on the base wall panel 86B. Since much of the weight of a cathode ray tube is at the front, compensating weights, in the form of metal rollers, may be added at the rear, to counterbalance the sub-assembly and the module itself. These rollers are most conveniently secured to the support frame of the module, and are not shown in the drawings. They are of course designed to be removable.

When the sub-assemblies are loaded into the support frame, by sliding from the front, they are orientated so that the full-length wall panels coincide with the outer faces of the module 1. In this way, the half-length wall panels face one another within the module 1, and allow free access to the cathode ray tubes in the interior of the module. The corner edge joining both half-length wall panels will always coincide with the central horizontal axis of the module, in this particular example.

The support frame of the module has formations for securing hawsers for suspension of the module from suitable ceiling or roof mounts. The frame also has fixtures for connection to adjacent modules. Where a module is intended to be secured to an adjacent module, the outer panels, secured over the frame and behind the front portions of the sleeves, would be removed to allow mutual interfacing of the frames of adjacent modules.

The monitors are driven electrically by a video image processor which is mounted within the support frame of the module, usually on the bottom rear section of a back plate. Access ports, connectors and potentiometers, etc. can then be accessed through the back plate. The bottom third section of the back plate

can be permanently fixed to the frame, with the video image processor on its inside, whilst the upper two-thirds section can be removable, housing only a ventilation fan, allowing easy access and servicing of the module.

With reference to Figure 8, the video image processor comprises a programmable video wall controller 100 to which is connected a control port and a video input terminal, and receives power from a switched mode mains distribution unit 101, connected to mains power. Four outputs from the programmable video wall controller 100 are connected to respective tube drivers 102-105, each of which receives mains power from the mains distribution unit 101, the tube drivers being connected to respective monitors 31-34.

Although not shown in the drawings, each module may be provided with an internal electric lamp inside its housing, for illuminating the interior for servicing, and preferably of sufficient power to provide anti-frost and anti-condensation protection for the interior when the module is used outdoors.

The programmable video wall controller 100 has the following functional blocks: a colour decoder; digitizers; four memory cards; a system manager and two clock generators. The colour decoder accepts the video input in any of the popular formats (VHS, SVHS, RGB) and outputs separate red, green and blue signals at standard levels. The digitizers convert the RGB signals into digital format for driving the digital video data bus, which in turn drives each of the four memory cards. Each memory card contains two banks of memory that are used on alternate image fields: one bank processes even fields of the video image and the other processes odd fields. One clock generator is for writing, and one for reading, to supply control signals to the memory cards

together with matrix management signals from the system manager.

By controlling the write and read clock rates, the output image can be expanded by a factor of 2, 4, 6, 8 or 16. This allows each screen to display an appropriate fraction of the overall image.

The control system can be divided into two functional parts: the master software which comprises the presentation authoring software, and the slave software, or player, which may reside locally or remotely. In the example shown, the slave software is remote. The master software allows the production to be authored as required, and the player allows these authored productions to be played back exactly as authored.

The master software is a totally-integrated software package which features a "point and click" graphical user interface, all-image-based authoring and file handling and a full on-line help system. Presentations may be created from text alone, from text with photographic background (scanned from a supplied rostrum camera), or from videotape. Each page of a presentation is created in the page layout editor which also features an image compositor for special video wall effect and layout. A sophisticated text editing system allows multi-coloured text with or without special effects to be placed and moved over a photographic background. Once the page layout is complete, the page is added to the presentation sequence and/or stored to disk for future use.

The pages are sequenced in the sequence editor which allows the display time and special transaction effect to be set for each page. Video may be incorporated accurately into a presentation frame via a VTR S9 controller, which is fully SMPTE time code compatible. Sequences may be edited with cut, copy, paste and insert functions, and finished products are automatically

stored to disk. Completed presentations may be played directly from the master software via a preview option, or they may be data uplinked to a remote slave system via standard telephone lines using built-in uplink software.

The slave software or presentation player may be involved locally via the master software "preview" option, to play the current presentation; alternatively, it may be operated on a remote slave site system. When operating as a remote site, the software automatically detects and answers a call for data uplink by the master system. The new presentation is down linked automatically and stored to local storage. The system will then intelligently clear out old presentation data to prevent disk overflow, and will restart the presentation. This whole process is automatic, and requires no user intervention. Should the presentation be authored to use video tape, the remote site will play the tape frame accurately against the original master production.

Special features of this control system include the fact that both master and slave software will automatically reconfigure for PAL/NTSC display sizes. Further, video wall display modes can be authored as part of the presentation, allowing page by page display changes. The system can work in both standard and video display resolutions. Uplink, video control and composition systems can be configured at the start up of the system. The colour display mode is selectable, for example in the range 4,096-256,000 pixels, with eight colour text lockout. The system allows digital video previewing to quarter-screen size. External communications ports are provided for synchronization with other software modules, for example software modules intended for Superbowls. The system software is intended to be fully multitasking.

In an alternative embodiment of the invention, the monitors may be fitted into a suitably adapted frame without their sleeves. In this case, the front face of the module frame would support much of the weight of the monitors, and would support the bending moment of the monitors due to their centres of gravity being behind the front part of the module frame, to which they are attached. The corner fixing lugs 6 then each have a recess as shown in Fig. 3, on the diagonal line of the tube, for receiving a clamping bolt located on the central horizontal axis of the module. The frames of adjacent modules are preferably releasably connectable across the interfaces by bolts which can be accessed from the interior of just one of the modules.

## Claims:

1. A video display module for a video wall, comprising an assembly of multiple video display units whose front edges are abutting and are all in the same plane as a rectangular array, and a common box-shaped enclosure for the assembly.
2. A module according to Claim 1, in which there are at least two video display units in each of the dimensions of the rectangular array.
3. A module according to Claim 2, in which the assembly is a 2x2 assembly.
4. A module according to Claim 2, in which the assembly is a 3x3 assembly.
5. A module according to any preceding claim, including support means for attachment to corresponding support means on an adjacent such video display module whereby to join the modules face to face with all the front edges lying in the same plane.
6. A module according to Claim 5, in which the support means includes a load-bearing frame which holds the front edges rigidly adjacent one another, against the bending moment of the weight of each video display unit, and also is capable of supporting the weight of at least one such module from above, under compressive loading, or at least one such module suspended below, under tensile loading.
7. A module according to Claim 5 or 6, in which the support means comprises bolts for releasably connecting the frames across an interface between two such modules,

upon access from the interior of just one of the modules.

8. A module according to Claim 7, in which the support means comprises means for attaching hawsers for suspending the module.

9. A module according to any preceding claim, in which the enclosure comprises panels releasably attachable to the frame to form an exterior wall of the module or an exterior wall of two or more joined modules.

10. A video display system comprising a plurality of video display units arranged in a rectangular array, and an electronic control system arranged to receive one or more video input signal(s) and to display the signal(s), and switchable between modes either to make the image appear over two or more units with different parts shown on different units, or else to make the whole image appear on each of two or more units.

11. A system according to Claim 10, comprising a programmable memory for a predetermined sequence of switching between the said modes and/or between different signal sources.

12. A system according to Claim 10 or 11, comprising a remote master control system which controls the operation of two or more of the said video display systems.

13. A system according to Claim 10, 11 or 12, comprising means for mixing video inputs from different sources.

14. A cathode ray tube with corner mounting lugs specially formed such that their edges do not project beyond the tangents from the major edges of the screen.



15. An assembly of cathode ray tubes, each in accordance with Claim 14, in a rectangular array of at least 2x2, with middle portions of their adjacent edges contiguous.

16. A sleeve for a cathode ray tube, in the form of an open-ended rigid box, the front open end of the box comprising a rectangular-section frame for supporting the screen of the cathode ray tube, with formations on the inside of the corners adapted for fixture to corner lugs of the cathode ray tube.

17. A sleeve for a cathode ray tube, in the form of an open-ended rigid box, a front open end of the box comprising a rectangular-section frame for supporting the screen of the CRT, the frame having openings over the middle portions of its four front edges, intermediate its corners, to allow the edges of the screen to touch a corresponding edge of the screen supported in an identical sleeve disposed adjacent the sleeve, with the screens co-planar.

18. A sleeve according to Claim 17 having formations according to Claim 16.

19. A sleeve according to Claim 17 or 18, in which the open-ended rigid box has a rear portion which depends rearwardly from the rectangular-section frame so as to surround the sides of the cathode ray tube in use.

20. A sleeve according to Claim 19, in which the rear portion has four side walls, of which at least two are substantially shorter than the others, to facilitate access into the sleeve behind the cathode ray tube in use.

21. A pre-assembly comprising a cathode-ray tube held rigidly within a sleeve according to any of Claims 16 to 20.

22. A video display module comprising a frame adapted to receive serially, and to provide independent support for, a plurality of pre-assemblies according to Claim 21, in a rectangular array with the screens all co-planar.

23. A module according to Claim 22, in which the frame is formed with rails extending horizontally in use for receiving the pre-assemblies by providing sliding support for their lower edges.

24. A module according to Claim 22 or 23, in which the sleeves are in accordance with Claim 20, and are mutually orientated such that the shorter side walls of at least two of the pre-assemblies are opposed, to facilitate access to the rear of the cathode ray tubes.

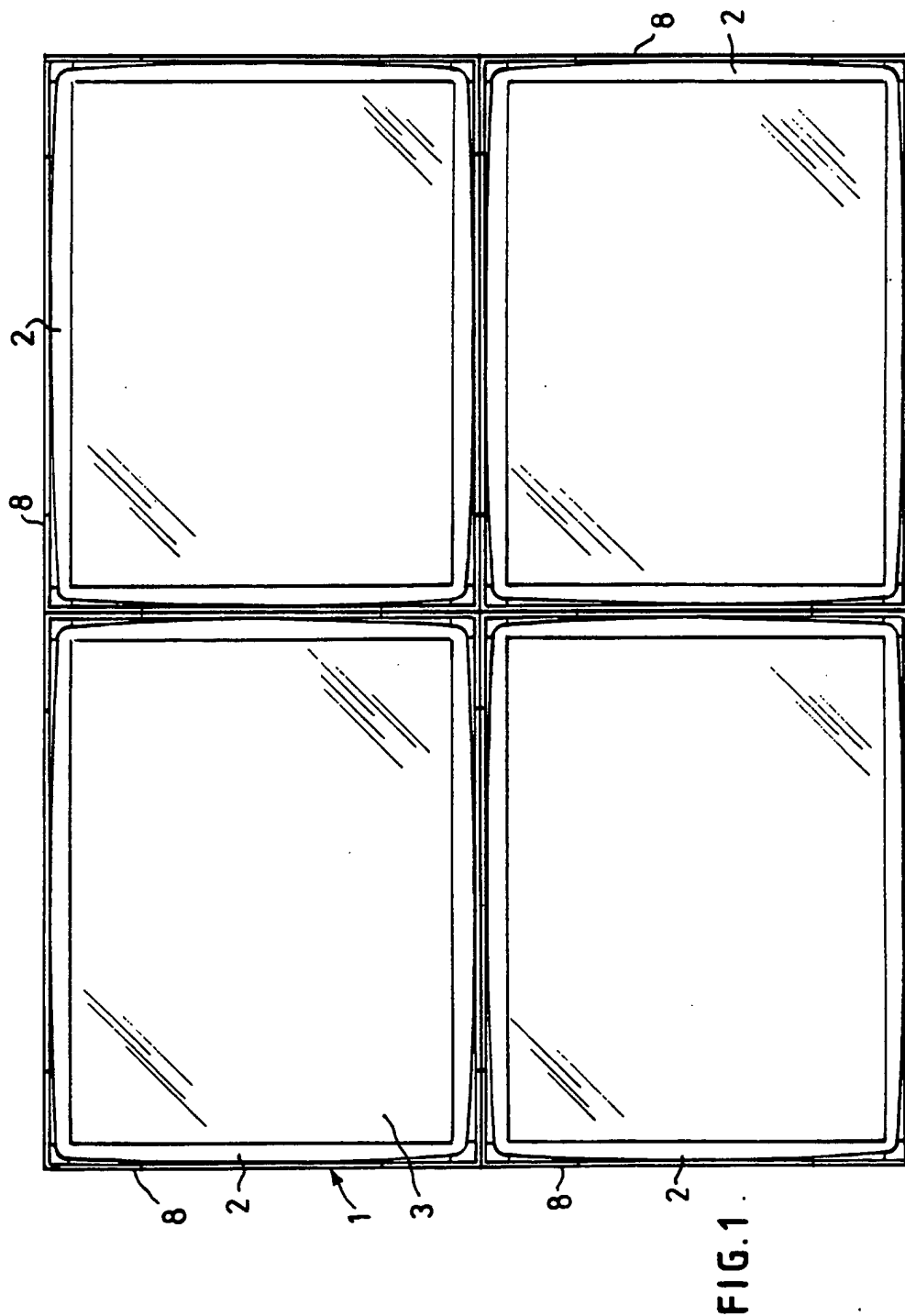
25. A method of assembling a module according to Claim 22, 23 or 24, comprising sliding horizontally, from the front, successive ones of the pre-assemblies into the frame and fixing them in place in the frame.

26. A sleeved cathode ray tube, substantially as described herein with reference to the accompanying drawings.

27. A video wall, substantially as described herein with reference to the accompanying drawings.

28. A method of assembling a video wall, substantially as described herein with reference to the accompanying drawings.

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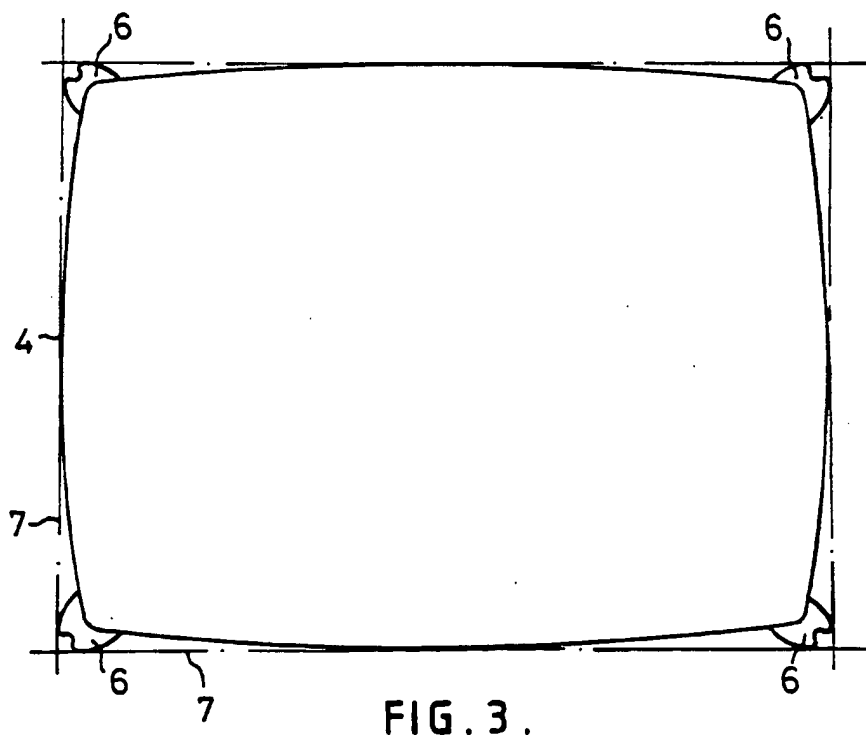
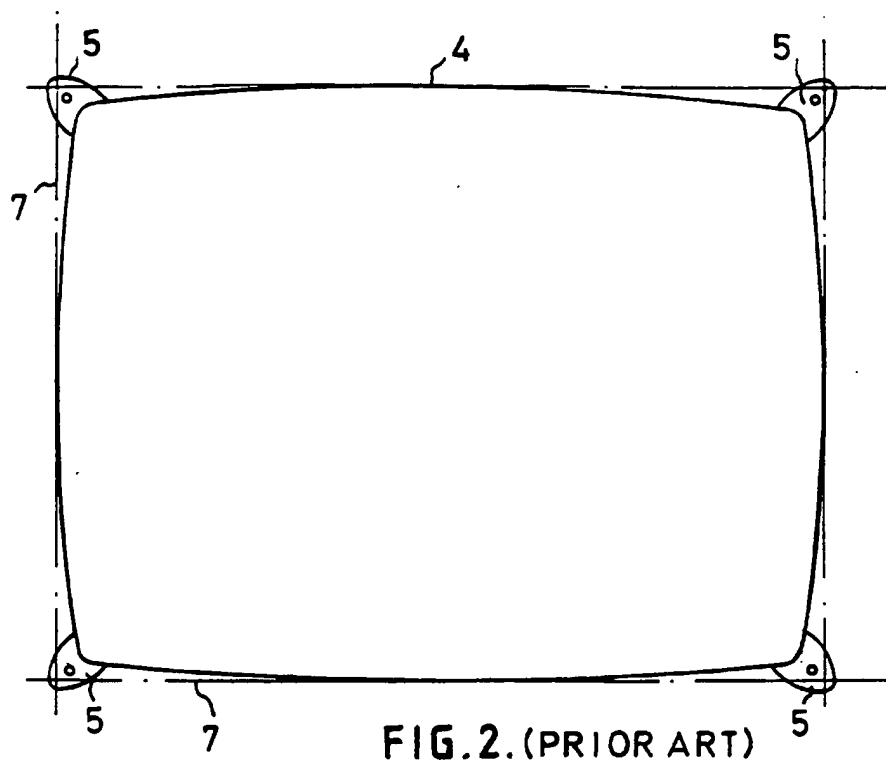
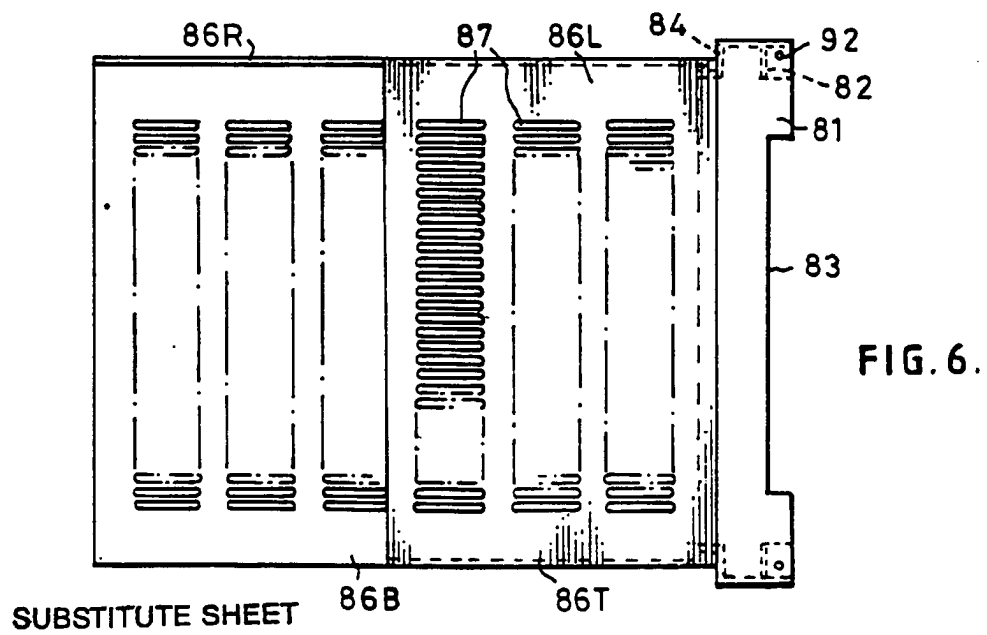
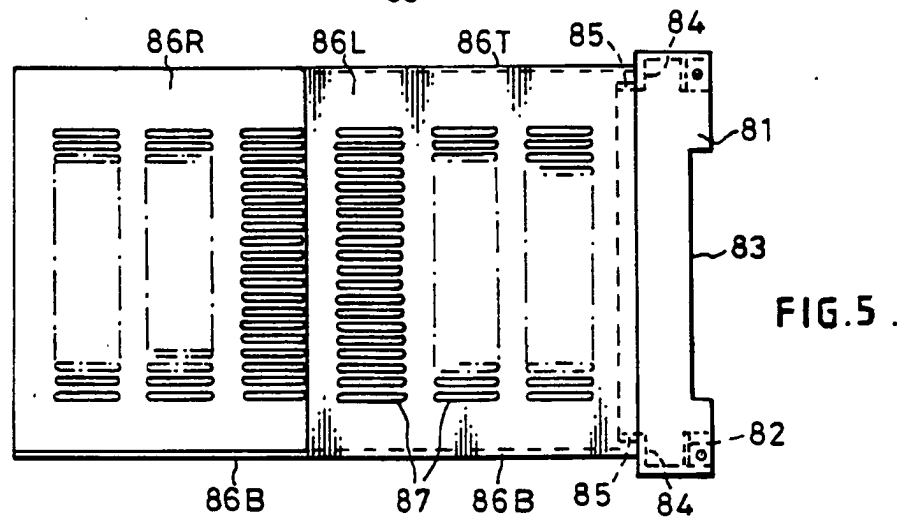
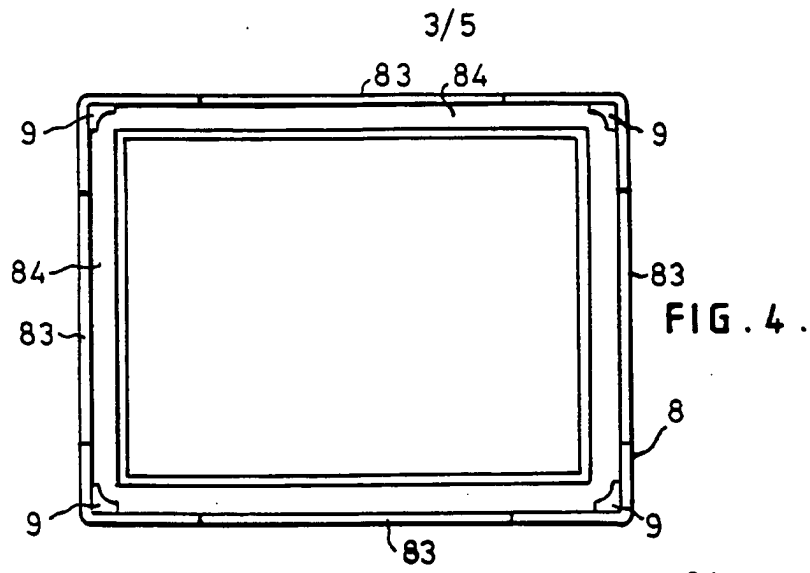


FIG. 3.

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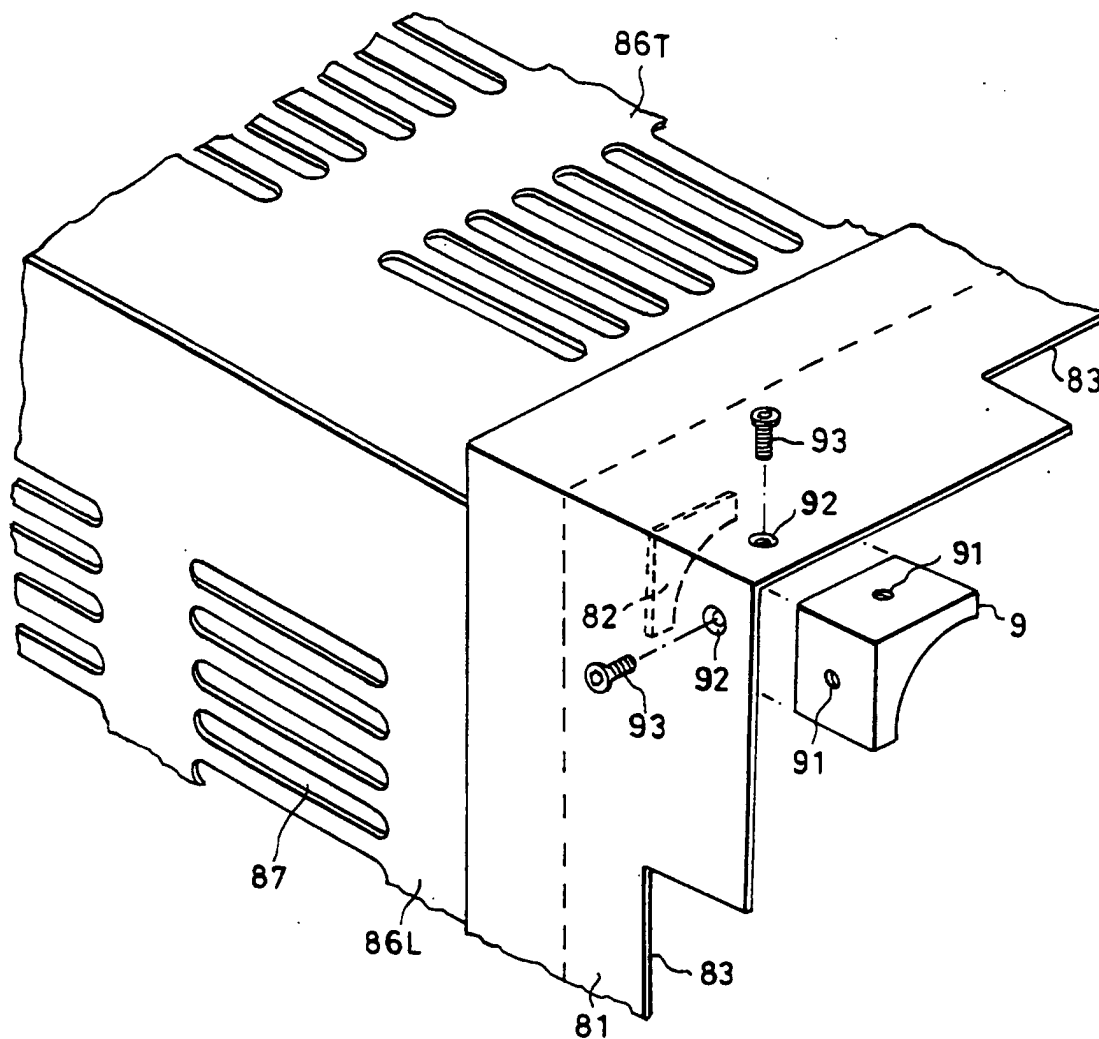
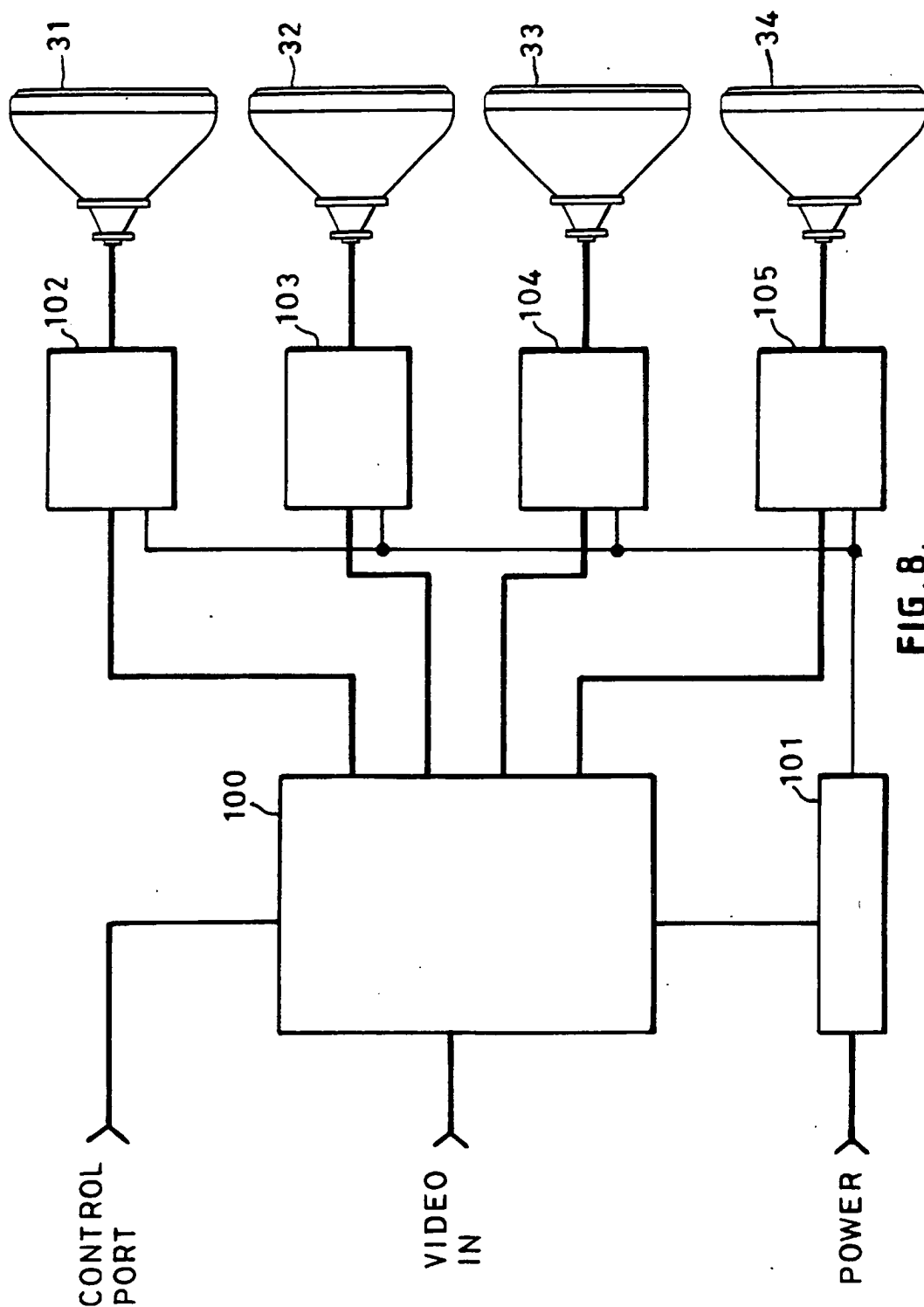


FIG. 7 .

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# INTERNATIONAL SEARCH REPORT

Intern. Application No

PCT/GB 94/00125

A. CLASSIFICATION OF SUBJECT MATTER  
IPC 5 H04N9/12

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)  
IPC 5 H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	GB,A,2 248 005 (PIONEER ELECTRONIC CORPORATION) 18 March 1992	1-6
A	see page 9, line 5 - page 17, line 6 ---	7-9
X	EP,A,0 331 847 (PIONEER ELECTRONIC CORPORATION) 13 September 1989	1-6
A	see column 3, line 26 - column 5, line 35 ---	7-9
X	EP,A,0 376 332 (SONY CORPORATION) 4 July 1990	1-4
A	see column 7, line 49 - column 8, line 24 ---	10
A	GB,A,2 236 447 (K. C. TUNG) 3 April 1991 see page 3, line 18 - page 4, line 9 ---	1-9
A	DE,A,31 35 068 (MANFRED KAGE INSTITUT) 24 March 1983 see the whole document ---	1-4,10
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☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

\* Special categories of cited documents :

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Date of the actual completion of the international search

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# INTERNATIONAL SEARCH REPORT

Intern. Application No

PCT/GB 94/00125

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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**INTERNATIONAL SEARCH REPORT**

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